

wald and St. Joseph on the 24th. The average precipitation was 3.41, or 0.25 above normal; the greatest monthly amount, 6.50, occurred at Brownsville, and the least, 0.29, at Pope. The lack of sufficient rainfall during the first half of the month was quite seriously felt by late and unmaturing crops, and it delayed the preparation of the soil for fall seedings, but otherwise conditions favored the gathering, in good condition, of those crops that were maturing.

Texas.—The mean temperature was 0.9° above normal; there was a general excess, except over the Panhandle and the extreme eastern portion of the coast district, where it ranged from about normal to 4° below, with the greatest deficiency in the vicinity of Amarillo. The excess in temperature ranged from 0.3° to 1.4° over north and west Texas and the central and west coast district, from 1.5° to 2° over central and southwest Texas, and from 2.1° to 3.8° over east Texas, with the greatest excess in the vicinity of Palestine. The maximum was 110° , at Mann on the 5th, and the minimum, 33° , at Mount Blanco on the 28th. The average precipitation was 1.13 above normal. There was a general excess, except along the immediate coast and over the eastern and central portions of north Texas, where there was a deficiency ranging from 0.01 to 4.01, with the greatest in the vicinity of Galveston. The excess ranged from 0.08 to 1.24 over west Texas, the Panhandle, the western portion of north and central Texas, and the eastern portion of east Texas, and from 1.22 to 6.03 over southwest Texas, the eastern portion of central Texas, and the western portion of east Texas; the greatest excess was in the vicinity of Hearne and Golindo. The precipitation was not well distributed during the month, there being almost a total absence during the first and second decades and general excessive rains during the third decade, especially over the central portions of the State.

Utah.—The mean temperature was 61.0° , or about 3.0° below normal; the highest was 100° , at Manti on the 3d and St. George on the 4th, and the lowest, 16° , at Richfield on the 27th. The average precipitation was 1.00, or slightly above normal; the greatest monthly amount, 5.97, occurred at Moab, and the least, 0.12, at St. George.

Virginia.—The mean temperature was 67.9° , or 0.1° above normal; the highest was 99° , at Petersburg on the 18th, and the lowest, 20° , at Guinea on the 24th. The average precipitation was 4.94, or 0.47 above normal; the greatest monthly amount, 8.47, occurred at Woodstock, and the least, 2.67, at Manassas. The predominant feature of the month was the West India hurricane which swept over the State on the night of the 29th. This storm, which had been traveling slowly northward from the Gulf of Mexico for several days prior to its passage across this section, seemed to concentrate its fury in Virginia, and left death and destruction in its wake. The area of greatest violence would

probably be comprised within a line run due north from Southampton County, on the east, and one run north by west from Mecklenburg County, on the west, comprising the central two-thirds of the State. In cities buildings were razed and unroofed, trees uprooted and broken, and, in some cases, lives lost, while in agricultural communities farm products, fodder, fencing, outbuildings, orchards, etc., were destroyed. The value of property lost will probably amount to over \$1,000,000. Phenomenal rains occurred over Augusta and adjoining counties, causing floods and washouts and loss of life and property.

Washington.—The mean temperature was 56.4° , or 0.8° below normal; the highest was 98° , at Fort Simcoe on the 6th, and the lowest, 18° , at Cascade Tunnel on the 16th. The average precipitation was 1.17, or 0.87 below normal; the greatest monthly amount, 2.80, occurred at Queets, and the least, 0.12, at Fort Simcoe.

West Virginia.—The mean temperature was 65.2° , or about normal; the highest was 95° , at Philippi on the 14th, and the lowest, 22° , at Beckly on the 22d. The average precipitation was 4.59, or 1.50 above normal; the greatest monthly amount, 9.04, occurred at Bloomery, and the least, 1.58, at Beckly. By far the greater part of the month's rain occurred on the 29th and 30th during the passage of the hurricane which swept the country from the Gulf to the northern boundary, and which caused such immense loss of property and several lives. Heavy rains fell in all sections of the State, the fall in the eastern portions being exceedingly heavy. Reports show a very considerable damage to property of various kinds and serious washouts on railroads. The observer at Martinsburg reports a terrible storm on the 29th. Trees were uprooted, houses and fences blown down, the streams rose suddenly and great damage was done to crops along the lowlands. The observer at Old Fields reports that the freshest of the 30th washed away a large amount of corn, hay, and clover seed, and some cattle, horses, and hogs were lost. The eastern and northern counties suffered most severely from this storm, the western portions receiving only heavy rains and moderately strong winds.

Wisconsin.—The mean temperature was 55.9° , or 4.1° above normal; the highest was 90° , at Racine on the 2d, and the lowest, 19° , at Amherst on the 20th. The average precipitation was 4.34, or 1.06 above normal; the greatest monthly amount, 9.58, occurred at Sharon, and the least, 1.27, at Bayfield.

Wyoming.—The mean temperature was 54.1° , or about 4.0° below normal; the highest was 99° , at Wheatland on the 6th, and the lowest, 19° , at Cheyenne on the 27th and Wise on the 26th. The average precipitation was 1.64, or about 0.90 above normal; the greatest monthly amount, 3.35, occurred at Sundance, and the least, 0.40, at Wheatland

SPECIAL CONTRIBUTIONS.

THE WIND-RUSH OF SEPTEMBER 29, 1896.

By Prof. H. A. HAZEN (dated October 2, 1896).

On the night of September 29 there occurred the most destructive storm that ever visited Washington, and it merits special study. The weather map at 8 p. m. shows a general storm with lowest pressure, 29.30 inches, at Lynchburg, Va. The lowest pressure at Washington, 29.14 inches, occurred at 10.50 p. m. The wind velocity continued very high from 10.55 to 11.48, and at times reached 70 miles per hour. The destructive wind had a general southerly direction, but came a little from the east on the east side of the city, and from the west on the west side. In Alexandria the wind was nearly southeast.

(a) WASHINGTON, D. C.

The most remarkable fact noted was that the destruction was in well marked streaks and not universal. In hundreds of instances a well constructed roof, rafters and all, was blown off, while close by very frail structures at the same height were uninjured. In some cases this effect was undoubtedly heightened by the formation of eddies in the streets, and by the reinforcement of the wind blowing along streets running north and south, but making due allowance for all such cases, there was the clearest evidence that there was not a steady blow over the whole region, but that there were streaks or wind-rushes at various points and along certain well-defined lines. There is also evidence to show that the wind did not bear a definite relation to the baric gradient, for it died down quite rapidly after the maximum period had passed, while the gradient continued for a much longer time.

At the Abert building on Pennsylvania avenue the west wall of the two top stories was blown out, and falling upon a low building it broke through the roof and killed one man. This building had been built very recently, and had not, up to that time, received the glass in either front (south) or back (north) windows, but these were covered with cotton cloth. The singular fact is that the cloth in the back windows was not disturbed. The east and west walls trended about 20° east of north and west of south, and the southeast wind struck them almost at right angles. It seems possible that the blow from the wind was so sudden that the west wall gave way and relieved the pressure before the cloth could be blown out of the back windows. Some have considered that possibly a vacuum on the back of this west wall would have caused a pressure even as high as 2,000 pounds to the square foot. It is known, however, that the utmost vacuum that could have been caused by the wind upon the plane surface would not produce a pressure greater than 8 or 10 pounds per square foot.

On K street, NW., between Thirty-first and Thirty-second streets, two walls were forced out under peculiar conditions. Both walls were on the east side of buildings with a hip roof, the ridge pole running east and west. The windows were all closed so that the pressure on the inside must have been insignificant. Each wall gave way under its roof, which remained intact. There could have been no sudden withdrawal of air pressure from the outside for the reason that the storm was moving north quite slowly, and there was no sudden or marked change in pressure. It seems possible that

these walls were drawn out by the diminished pressure caused by the southwest wind blowing along the roof and side of the house.

The steeple of the New York avenue Presbyterian Church was blown down and appeared almost as if it had been picked up, turned upside down, and dashed down on its point. In the country about Washington there were two streaks of destruction that were well marked. One of them was about 2 miles beyond Cabin John Bridge on the Conduit road, and the other near the Tennallytown pike. A careful search along Seventh street and the Chevy Chase road showed very slight action. On either side of Fourteenth street, however, there was serious destruction to trees and roofs. The official estimate of the total loss to structures throughout the whole city puts it at \$400,000.

(b) ALEXANDRIA, VA.

It was commonly reported that the worst destruction had occurred at Alexandria, but the facts do not bear out this assertion. There was no tornado track or even the semblance of one. The wind carried the roofs that were blown off a little farther than in Washington, and the unroofing of houses and factories along the river front was quite serious, but aside from this there was little serious destruction.

A church at the corner of Princess and Patrick streets had its roof crushed in, but singularly enough, the tower, which was much taller than the church, was not injured in the least. There was every evidence that the southeast wind struck the east roof of the building (whose ridge pole stretched north and south) and crushed it in because of a great weakness in the timbers supporting the roof.

Every place was visited by me where inquiry showed a visitation of the wind rush. The estimated loss to structures was greatly exaggerated. Four lives were lost. In one case the west brick wall of a 3-story house was drawn out by the wind and crushed through the roof of a lower neighboring house, killing a man in the top story. The streakiness of the wind was far more marked in Alexandria than in Washington, and it was found possible to follow these streaks over much greater distances.

KITE EXPERIMENTS AT THE BLUE HILL METEOROLOGICAL OBSERVATORY.

By S. P. FERGUSON (dated August 26, 1896).

Kites were first employed at Blue Hill Observatory in observations of atmospheric electricity, by Mr. Alexander McAdie, in the summer of 1885. The kites used were coated with tin foil, and served as collectors; the current passed down a copper wire to the electrometer at the ground. No high flights were attempted. These experiments were repeated by Mr. McAdie in June, 1891, and July, 1892.

In July and August, 1894, Mr. William A. Eddy, of New York, who had been very successful in reaching great altitudes with kites of the so-called "Malay" type, spent two weeks at Blue Hill for the purpose of employing the kites designed by him in meteorological observations. It became very evident after a few days of experimenting that the Eddy kites could be utilized to elevate self-recording instruments, and on August 3 an ordinary Richard thermograph was altered for use in the experiments. The heavy parts were replaced by wood and aluminum, and the modified instrument, with a small basket inverted over it to serve as a screen for the bulb, weighed altogether 2 pounds and 5 ounces. On August 4, 1894, this instrument was twice elevated to a maximum height of 1,430 feet (the height being determined from angles taken at the ends of a 300-foot base line), and an excellent temperature record was obtained. Five Eddy kites, having a total area of about 100 square feet, were employed. This is believed to be the first use of

kites for elevating self-recording instruments. The first experiment was repeated with equal success on August 15. A detailed account of the two ascensions, prepared by Mr. Clayton, appeared in the American Meteorological Journal for December, 1894; details of the kites and thermograph were also published in the Scientific American for September 15, 1894.

The experiments were resumed in June, 1895, and since then have been made, under the direction of Mr. A. Lawrence Rotch, by Mr. Clayton, Mr. Sweetland, and the writer. Before any ascensions were attempted careful tests of materials for kites and line were made, and a windlass constructed. By the 23d of July a number of serviceable kites were ready and observations were recommenced on that date. Early in August a baro-thermograph, similar to the first instrument, and weighing 2 pounds, was constructed and observations begun with the new instrument. The first Hargrave kite made at the Observatory was flown on August 18, 1895. Mr. Eddy returned on August 17, and remained until September 6, experimenting with kites and making photographs from the kites at elevations of a few hundred feet. Ascensions with the baro-thermograph to an average altitude of about 1,200 feet were also made almost daily during this time. The maximum height reached was 1,916 feet on August 28, with 3,500 feet of line and seven kites. An improved Hargrave kite was first used for lifting the baro-thermograph on September 21, an altitude of 1,600 feet being reached. The baro-thermograph was lost on September 22, 1895, and no further experiments except in improving the kites (both Eddy and Hargrave patterns) were made until November 16. By that time a new instrument, for recording wind velocity and temperature, had been constructed, and was used for the first time on that date; this was probably the first recording anemometer elevated by kites. Ascensions to heights of 1,000 to 1,500 feet were made about twice in each week after that date.

On January 27, 1896, steel music wire was substituted for cord as a main line, and proving to be greatly superior to cord was afterward used exclusively.

During the winter of 1895-96, some records were obtained during rain and snowstorms by using kites, rendered waterproof by varnish. On March 11, 1896, an ascension was made during a severe northeast gale. The recording instrument elevated by two Hargrave kites disappeared in the clouds at a height of 2,000 feet. An altitude of about 3,300 feet was reached, but the instrument was clogged with frostwork and snow, and the record was lost after the clouds were reached. On April 4 a meteorograph, recording pressures by aneroid, as also temperature and humidity, was received from Richard Brothers of Paris, and its use begun. An altitude of 3,964 feet above the hill was attained with this instrument on April 13.

In July, 1896, at the suggestion of Mr. Douglas Archibald, of England, a tail made of cloth cones was attached to one of the Eddy kites, greatly improving its stability.

On July 20 the height of a mile above the hill was reached for the first time, and on August 1, 6,703 feet, the maximum elevation attained so far.

The method followed has been to conduct experiments with the recording instruments in connection with the tests of materials and different forms of kites, as in this way it was found possible to adapt the kites to the work required of them more readily and thoroughly than by perfecting one department of the investigation before beginning the other. Except when the altitude of clouds was measured, the recording instrument was sent up during every ascension with the tandem line, and in this way the most economical use of the kites was made.

During the first eight months the cord used for a main line was what is known as "blocking cord,"—a hard-twisted linen